United Kingdom

2501045714

UNITED KINGDOM STANDARDS

Reference No.	Standard No.	Title
UK 1		Building Regulations Part F. 1985 Department of Environment. Revised 1990.
UK 2		Building Regs Part J.1985 Department of Environment. Revised 1990.
UK 3		Scottish Building Regs Part K.1988 Draft. Department of Environment.
UK 4	BS5925:1990 80	Code of Practice for design of Buildings: Ventilation principles and designing for natural ventilation.
UK 5	BS5720:1979	Mechanical Ventilation
UK 6	BS5250:1989	Basic data for the design of buildings: the control of condensation in dwellings.
✗ UK 7	BS6375:1983	Performance of windows.Part 1: classification of weathertightness.
✗ UK 8	BS6229:1982	Practice for Ventilation of flat roofs.
UK 9		Determining air tightness of buildings.
✗ UK 10	BS5368 Pt 1:1976	Methods of testing windows.Part 1 Air Permeability Test.
UK 11	88/13390 Draft	Specification for Draughtstrips for the draught control of existing doors and windows in housing (Including test methods) Anticipated Publication Feb/Mar. 1990.

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UNITED KINGDOM Ref:UK.1

Building Regulations 1985 Part F. Revised 1990.

Department of the Environment.

This is a document approved by the Secretary of State as practical guidance to meet the requirements of the Building Regulations with regard to providing means of ventilation and to minimising condensation in roofs. There is no obligation to adopt any particular solution in the document, provided it can be demonstrated that the requirements have been met by other means.

Other Standards referred to:

BS.5925:1989.	Code of Practice for design of buildings: Ventilation principles and designing for natural ventilation.
BS.5720:1979	Code of Practice for mechanical ventilation and air conditioning in buildings.
BS.5250:1989	Code of basic data for the design of buildings: the control of condensation in dwellings.
BS.6229:1982	Code of Practice for flat roofs with continuously supported coverings.

F1 - means of ventilation

Adequate supplies of air for ventilation shall be provided for people in dwellings, rooms containing sanitary conveniences, and bathrooms.

The requirements will be satisfied if there is:

(a) for rapid ventilation one or more ventilation openings with a total area of at least 1/20th of the floor area of the room, and with some part of the ventilation opening at least 1.75m above the floor level, e.g. an opening window; and

(b) for background ventilation a ventilation opening (or openings), having a total area not less than 4000 square millimetres, e.g. a trickle ventilator. The opening(s) should be controllable and secure and located so as to avoid undue draughts.

Natural ventilation may be used, provided openings are based on the sizes given in Table 1.

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Table 1. Natural Ventilation Ref:UK.1

Room or Space	Ventilation to be provided (Ventilation openings)
1. In dwellings: habitable rooms, kitchens and bathrooms	At least one ventilation opening with an area of at least 1/20th of the floor area of the room or space. Some part at least of the ventilation opening to be at least 1.75m above the floor level.
2. In buildings containing dwellings:	At least one ventilation opening with an area at least 1/50th of the floor area of the space.
3. In any building: Sanitary accommodation	At least one ventilation opening with an area of at least 1/20th of the floor area of the room or space.

Mechanical ventilation must provide the air changes listed in Table 2 if the requirements are to be met.

Table 2. Mechanical Ventilation

Room or Space	Ventilation to be provided (air changes per hour)
1. Dwellings	
(a) habitable rooms	1
(b) kitchens	3
(c) bathrooms	3*
2. In buildings containing dwellings	
(a) common spaces	1
3. In any building	
(a) sanitary accommodation	3*

* Note: The ventilation may be intermittent but should run for at least 15 minutes after the use of the room or space stops.

2501045717

F2 - Condensation

This requirement applies only to dwellings and is to prevent excessive condensation in a roof void above an insulated ceiling.

It deals with both pitched and flat roofs and prescribes widths of continous openings at eaves level, and in some cases with outlets at high level, to promote a cross flow of ventilation to expel moisture laden air that has built up in the roof space.

Ventilation Openings in Roof Voids at Eaves Level

Roof	Width of opening at least equal to a continuous strip.
Pitched	10 mm
Flat	25 mm

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Building Regulations 1985 Part J

Department of the Environment.

This part of the regulation is to ensure that provision is made for supplying fresh air to heating appliances to give satisfactory combustion conditions and to expel the products of combustion from the building through flues.

Section 1 covers solid fuel and oil burning appliances with rated outputs up to 45 kw and Section 2 deals with gas burning appliances with rated inputs of up to 60 kw.

A Table showing the areas of openings for solid and oil fired appliances is given below:

Supply of air for combustion.
Section 1 Part A J/1/2/3

Table 1. Supply of Air for Combustion.

Type of Appliance	Type of Ventilation
Solid fuel burning open appliance	An air entry opening or openings with a total free area of at least 50% of the appliance throat opening area, - as defined in BS.8303:1986 Code of Practice for installation of domestic heating and cooking appliances burning solid mineral fuels.
Other solid fuel appliance	An air entry opening or openings with a total free area of at least $550mm^2$ per kW of rated output above 5kW. Where a flue draught stabiliser is used the total free area should be increased by $300mm^2$ for each kW of rated output.

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UNITED KINGDOM Ref:UK.3

Scottish Building Regulations

Part K. Ventilation of Buildings Draft dated December, 1988.

The intention of this part is to ensure an adequate supply of air available for human occupation of a building which may be provided by natural means, natural with mechanical assistance, or wholly mechanical systems. It does not apply to buildings covered by the Factories Act 1961, but is intended for dwellings, garages and buildings other than dwellings or garages.

For dwellings ventilation must be supplied by either natural or mechanical means in accordance with Table 1.

Table 1. Ventilation Requirements for Dwellings

Space	Cross-sectional Areas Required for Natural Ventilation			Mechanical Ventilation
	Ventilator		Trickle Ventilator	
Habitable rooms	1/30th floor area	plus	4000 mm2 or	3 air changes per hour(1)
Kitchens	-		4000 mm2(2)	Extract (1) 64 l/s at full speed
W.C.	1/30th floor area		- or	3 air changes per hour.
Bathrooms & Shower rooms	-		-	28 l/s at full speed

(1) must be able to operate continuously at low speed.

(2) must be provided if (1) above is not employed.

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For buildings other than dwellings or garages, rooms must be provided with either means for natural ventilation or mechanical ventilation which is capable of continuous operation at low speed and designed in accordance with BS5720:1979 and the CIBSE Guide:1986.

Where natural ventilation is employed, the ventilator must have an opening area 1/30th of the floor area of the room. See Table 2.

UNITED KINGDOM Ref:UK.3

Table 2 Ventilation Requirements for Buildings Other than Dwellings or Garages.

Space	Cross sectional areas required for natural ventilation	Mechanical Ventilation
Room	1/30th floor area	Required if volume less than $5m^3$
Kitchens Cooking Prep.and wash up		Extract 20 air changes per hour 10 air changes per hour
Washrooms & W.C	1/30th floor area or	3 air changes per hour
Bathrooms & Showers		28 l/s at full speed
Communal laundry		Extract 10 ach (1)
Storage room more than $4m^2$ floor area	600 mm^2/m^2 of floor area	must be able to operate continuously at low speed.
Stairways and passages	800 mm^2/m^2 of floor area	must be able to operate continuously at low speed

(1) must be capable of continuous operation at low speed unless trickle ventilation provided.

Garages with floor areas greater than $30m^2$ must have provision for either natural or mechanical ventilation, and requirements are laid down based on their floor areas.

The locations of ventilation openings for both natural and mechanical ventilation is dealt with in the latter part of the regulation.

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UNITED KINGDOM Ref:UK.4

British Standards Institution BS 5925:1989

Code of Practice for: Design of Buildings : Ventilation principles and designing for natural ventilation.

The Code deals with ventilation of buildings for human occupation, and where possible, recommended quantative air flow rates are given for different types of buildings and rooms, characterized by usage. The basis for the choice between natural and mechanical ventilation is given, and guidance on the design of natural ventilation systems is included in this standard.

The design of mechanical ventilation systems is dealt with in BS 5720 (UK 5).

Outdoor air requirements based on degrees of activity are as shown in Table 1.

Table 1. Outside Air Requirements for Respiration

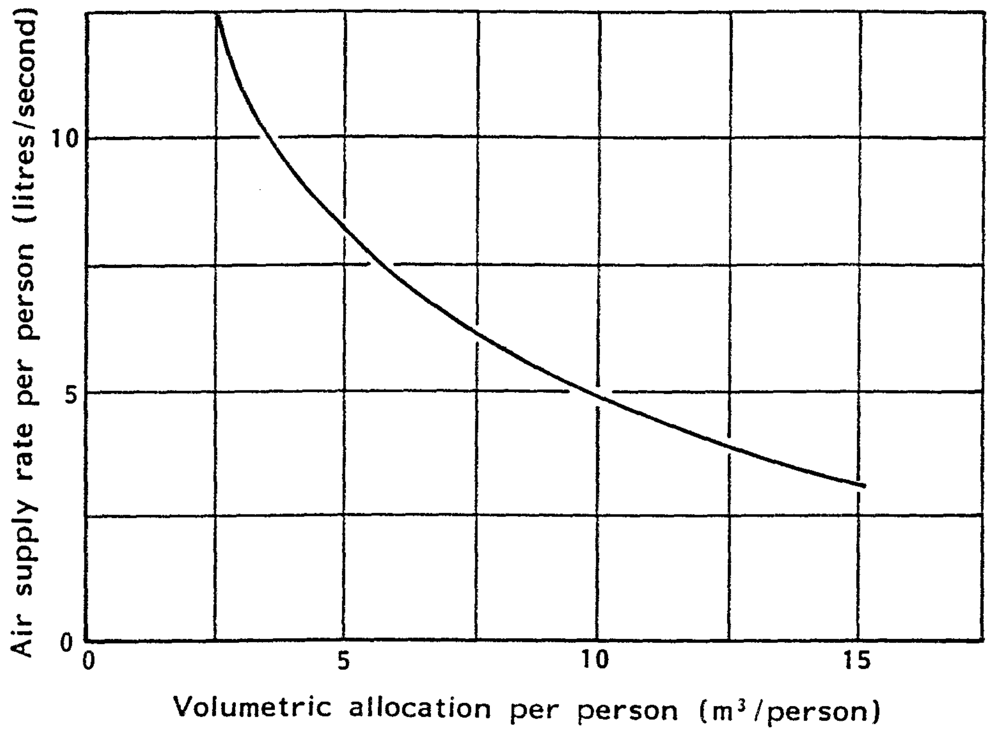
Activity (adult male)	Metabolic rate, M	Requirements for respiration; O concentration of 16.3% in expired air.	Requirements to maintain room CO2 at 0.5% assuming 0.04% CO2 in fresh air*
	W	litres/s	litres/s
Seated quietly	100	0.1	0.8
Light work	160 to 320	0.2 to 0.3	1.3 to 2.6
Moderate work	320 to 480	0.3 to 0.5	2.6 to 3.9
Heavy work	480 to 650	0.5 to 0.7	3.9 to 5.3
Very heavy work	650 to 800	0.7 to0.9	5.3 to 6.4

* The rate of production of CO2 in terms of metabolic rate M is 40 x 10 M litres/s where M is in watts.

2501045723

Contaminants in the air, particularly for industrial works, laboratories and commercial kitchens should be extracted mechanically as near the source as possible and is dealt with in BS 5720:1979. Odour and tobacco smoke nuisance is dealt with in more detail and a graph showing air supply rates per person based on the density of occupation is shown in Fig.1.

Figure 1. Air Supply for Odour Removal.



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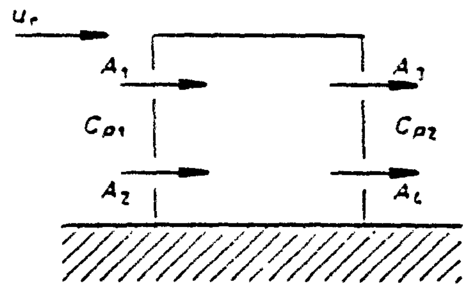
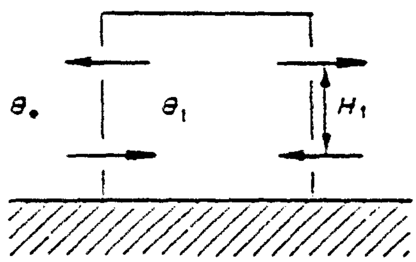
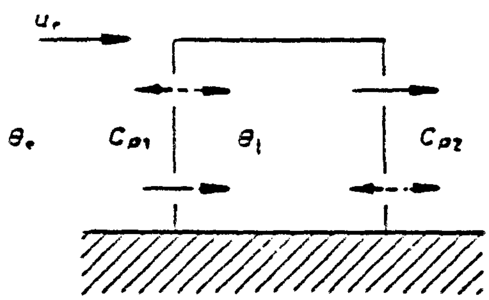
The design of natural ventilation is dealt with in depth covering the flow characteristics of openings such as windows of different types, air temperature, and wind speeds throughout the United Kingdom, and formula's for calculating flow rates for different arrangements of openings in simple buildings as shown in Table 2.

Table 2. Natural Ventilation of Simple Building.

Conditions	Schematic representation	Formula
(a) Wind only		$Q_w = C_d A_w u_r (\Delta C_p)^{1/2}$ $\frac{1}{A_w^2} = \frac{1}{(A_1 + A_2)^2} + \frac{1}{(A_3 + A_4)^2}$
Temperature difference only		$Q_b = C_d A_b \left(\frac{2\Delta\theta g H_1}{\bar{\theta}}\right)^{1/2}$ $\frac{1}{A_b^2} = \frac{1}{(A_1 + A_3)^2} + \frac{1}{(A_2 + A_4)^2}$
(c) Wind and temperature difference together		$Q = Q_b$ For $\frac{u_r}{\sqrt{\Delta\theta}} < 0.26 \left(\frac{A_b}{A_w}\right)^{1/2} \left(\frac{H_1}{\Delta C_p}\right)^{1/2}$ $Q = Q_w$ For $\frac{u_r}{\sqrt{\Delta\theta}} > 0.26 \left(\frac{A_b}{A_w}\right)^{1/2} \left(\frac{H_1}{\Delta C_p}\right)^{1/2}$

* It should be appreciated that, in practice, some openings exist unintentionally, e.g. junctions between building components, and that such openings will contribute to the ventilation actually achieved.

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UNITED KINGDOM Ref:UK.5

British Standards Institution BS5720:1979

Code of Practice for Mechanical Ventilation

This Code deals with the eowrk involved in design, installation, commissioning, operation and maintenance of mechanical ventilation and air-conditioning systems. The recommendations made in this code recognize the need to optimize the use of energy, reduce hazards and minimize effects detrimental to the environment. The increasing involvement of British engineers in projects overseas is noted and some guidance given in that context. In addition to this general section, the code is divided into the following seven sections:

Section 2. Fundamental requirements

Section 3. Design considerations

Section 4. Types and selection of equipment

Section 5. Installation

Section 6. Inspection, commissioning and testing

Section 7. Operation and maintenance

Section 8. Overseas projects.

For detailed design procedures, reference is made to:

1) Publications of the Chartered Institution of Building Services, particularly:

    The CIBS Guide
    CIBS Building Energy Code
    Technical Memoranda relating to fire and smoke control
    Practice Notes relating to provision of combustion and ventilation air for boiler installations;

2) The "Ductwork Specifications" published by the Heating and Ventilating Contractor' Association (HVCA);

3) ASHRAE Handbooks published by the American Society of Heating, Refrigerating and Air Conditioning Engineers.

For detailed commissioning arrangements:

1) CIBS Commissioning Codes;

2) BSRIA Application Guides published by the Building Services Research and Information Association.

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UNITED KINGDOM Ref:UK.5

Recommended minimum fresh air supply rates for air conditioned spaces are as follows:

Table 1. Recommended minimum fresh air supply rates for air-conditioning spaces*.

Typical type of space	Smoking	Outdoor air supply†		
		Recommended	Minimum (the greater of the two should be taken)	
		Per person	Per person	Per m^2 floor area
		dm^3/s‡	dm^3/s‡	dm^3/s‡
Factories§‖	None			0.8
Offices (open plan)	Some			1.3
Shops, department stores and supermarkets	Some	8	5	3.0
Theatres§	Some			–
Dance halls§	Some			–
Hotel bedrooms‖	Heavy			1.7
Laboratories‖	Some	12	8	–
Offices (private)	Heavy			1.3
Residences (average)	Heavy			–
Restaurants (cafeteria) ‖¶	Some			–
Cocktail bars	Heavy			–
Conference rooms (average)	Some	18	12	–
Residences (luxury)	Heavy			–
Restaurants (dining rooms)	Heavy			–
Board rooms, executive offices and conference rooms	Very heavy	25	18	6.0
Corridors				1.3
Kitchens (domestic)‖	A per capita basis is not appropriate to these spaces			10.0
Kitchens (restaurant)‖				20.0
Toilets §				10.0

*For hospital buildings (wards, operating theatres, etc.), see Department of Health and Social Security Building Notes.

†The outdoor air supply rates given take account of the likely density of occupation and the type and amount of smoking.

‡1 dm^3/s = 1 litre/s.

§See statutory requirements and local bye-laws.

‖ Rate of extract may be over-riding factor.

¶Where queuing occurs in the space, the seating capacity may not be the appropriate total occupancy.

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British Standards Institution BS 5250

Basic Data for the Design of Buildings: the control of condensation in dwellings.

This code of practice describes the causes and effects of condensation in buildings and gives recommendations for their control.

The principles of control and the recommendations given can be applied generally to all buildings, both new and existing, but those with internal environments or ventilation systems differing markedly from typical domestic situations may need special consideration and are outside the scope of this standard.

Methods are given to determine the occurrence and assess the effects of:

(a) surface condensation, or mould growth, one of its associated effects; and

(b) interstitial condensation.

Guidance is given on assessing whether any such condensation may be considered harmful.

Included within the code are typical ventilation rates for use in condensation calculations (see Table below) and details for ventilation provisions of roof spaces.

Table Typical ventilation rates

Description of Dwelling	Ventilation Rate ac/h
Well-sealed dwellings in sheltered position	0.5
Average dwelling in sheltered position	1.0
"Leaky" dwelling in sheltered position	1.5
Well-sealed dwelling in exposed position	1.0
Average dwelling in exposed position	1.5
"Leaky" dwelling in exposed position	2.0

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British Standards Institution BS 6375:1983

Performance of windows. Part 1: classification of weathertightness.

This standard gives a classification of windows for weathertightness in terms of exposure categories related to test pressure levels for air permeability, watertightness and wind resistance.

It is applicable to all types of windows in which any frame member is not longer than 3 m, and includes windows in which the opening lights are not fully framed, e.g. adjustable glass louvres and sliding windows.

The standard excludes patent glazing curtain walls that span across horizontal structural members of floors but includes the opening lights within a patent glazing or curtain walling system.

Guidance on the selection and specification of windows for weathertightness is given. Methods of calculating design wind pressure are also given.

The test method and sequence of tests is described.

Exposure categories are listed in Table 1. the corresponding air permeability requirement are given in Figure 1.

Table 1. Exposure categories

Exposure category (design wind pressure*)	Test pressure classes		
	Air permeability† (see figure 1)	Watertightness‡	Wind resistance
	Pa	Pa	Pa
1200 X	Up to 200 (graph A)	50	1200
1200	Up tp 200 (graph A)	100	1200
1600	Up to 300 (graph B)	200	1600
2000	Up to 300 (graph B)	200	2000
Over 2000 (state design wind pressure)	Up to 300 (graph B)	300	Equal to the actual design wind pressure

*The design wind pressure is calculated in accordance with the method given in appendix B.

†A test pressure class of 600 Pa (see figure 1, graph C) is applicable when stringent levels of performance are required, for example when exceptionally air tight windows are necessary as in air conditioned buildings. Where there is such a requirement the exposure category should be suffixed with 'special' e.g. 1200 special.

‡The watertightness test pressure classes given for the different exposure categories cover most situations. Windows of higher performance than stated in the table should be considered where there are local exposure conditions more onerous than those of the surrounding areas (see also note 3 to B.3).

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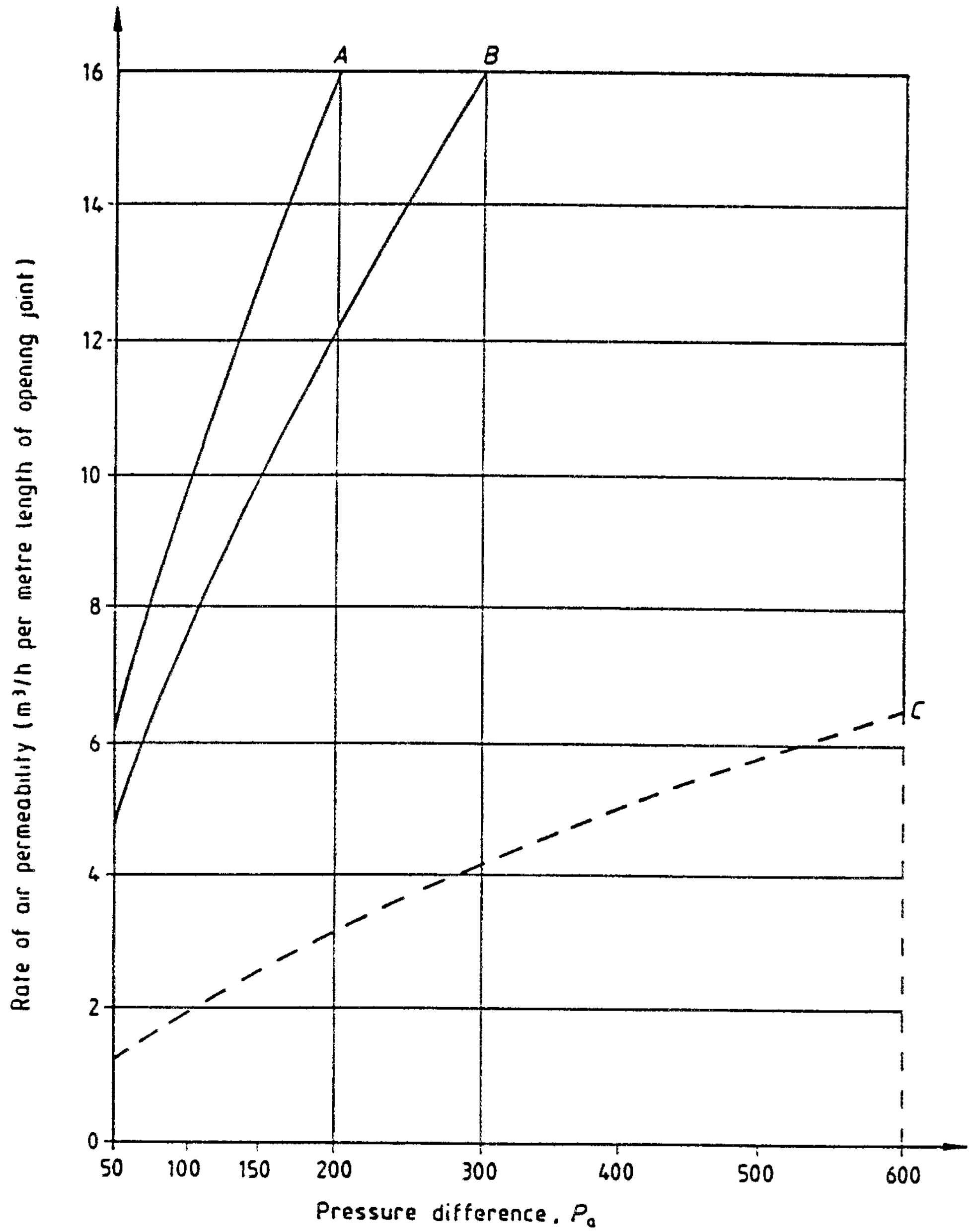
UNITED KINGDOM Ref:UK.7

Figure 1. Air Permeability Limits for Windows with Opening Lights



NOTE. The graph is based on the formula

$Q = kp^{2/3}$

where

Q is the leakage rate (in m^3/h);

p is the pressure difference (in Pa);

k is a constant:

$k_A = 0.4678$ (coordinates $Q = 16$ $p = 200$)

$k_B = 0.357$ (coordinates $Q = 16$ $p = 300$)

$k_C = 0.0928$ (coordinates $Q = 2$ $p = 100$)

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UNITED KINGDOM Ref:UK.8

British Standards Institution BS 6229:1982

Practice for Ventilation of Flat Roofs.

This code gives recommendations on the design and application of flat roofs with continuously supported roof coverings. Weathertightness, drainage, thermal and sound insulation, condensation control, structural support, fire precautions, maintenance and repair are considered.

Flat roofs are defined as those with roof coverings at slopes not exceeding 10 degrees to the horizontal. The recommendations given in this code may also be applied to roofs with slopes marginally greater than 10 degrees provided the design conditions are similar, but for steep roofs many of the recommendations may not apply.

This code does not deal with roofs with self-supporting coverings, nor with those for special purposes such as roof gardens, surfaces subject to heavy traffic, cold stores, and high temperature enclosures, nor with slated or tiled roofs.

Of specific importance is the ventilation of voids in cold roofs.

The code states that it is essential to ventilate the roof space in a cold roof to avoid the risk of condensation in the ceiling and the structural deck. The ventilation measures should provide a through path for the entry and exit of outdoor air.

Ventilation may be provided by holes or gaps through the fascia, soffit board or wall, detailed to avoid penetration of rainwater. Where insulation, fire stopping, cavity barrier or service installations prevent unobstructed ventilation between opporsite sides of the roof, it may be necessary to provide ventilation partly or wholly through the roof covering by means of suitable weatherproof roof ventilators.

Ventilation should be so arranged that all parts of the roof void are reached, avoiding stagnant air pockets, particularly at the upper parts of the void. Every void closed by imperforate beams, joists, fire stops, cavity barriers or other obstructions should be individually ventilated. In timber construction, the spaces between joists provide ventilation paths parallel to the direction of span, whereas the use of transverse purlins provide ventilation paths transverse to the direction of span; for ventilation purposes the choice of ventilation direction depends on the practicability of providing openings to the outside air at opposite ends (e.g. impractical at an abutment wall).

The desirable amount of ventilation varies with the external and internal climates, the thermal insulation provided and the resistance to air flow of the roof space (see BS 5925). Under average conditions, the total ventilation opening divided equally between opposite sides of the roof should be not less than 0.004 times the plan area of the roof. The roof void clear depth should be not less than 50 mm. To prevent entry of small birds, the gap width at the ventilation openings should not exceed 10 mm. To avoid excessive air flow resistance, the least dimension of any opening, including screen mesh apertures, should be not less than 8 mm.

Screen mesh materials should have adequate durability.

Wind-induced ventilation should not be relied upon for cold roofs exposed to continuous high indoor humidities; in such cases another roof type should be used, or warm dry air can be blown into the roof void at a sufficient pressure to prevent the entry of water vapour from the building.

UNITED KINGDOM Ref:UK.9

BUILDING RESEARCH ESTABLISHMENT

Determining the airtightness of buildings by the fan pressurisation method: BRE recommended procedure. by R.K. Stephen BSc.

This publication is written in the form of a "code of practice" and covers the significance of the method and its use; the requirements of the equipment used; the preparation and carrying out of the test and the data analysis.

Copies of forms are shown which should be used to ensure that all the relevant details of the structure are recorded together with the measurements and data obtained during the procedure of the test.

In contrast to tracer gas techniques, the fan pressurisation method of measuring air leakage characterstics is simple and inexpensive. It is relatively insensitive to prevailing weather conditions and a normal test can be carried out in less than two hours excluding the noting down of the construction details.

The four basic uses put forward for this method are:

1) to compare the relative airtightness of several dwellings.

2) to identify air leakage paths and the rate of air leakage from different components in the same envelope.

3) to measure the effect of draughtproofing or joint sealing

4) to assess the potential for air leakage reduction in a dwelling.

The method is to mount a fan on a board which can be sealed in a door or window, and to blow air into the building at a sufficient rate to be able to maintain a pressure differential between inside and out of up to 55 Pascals A typical fan capacity is given as 4000 m3/h for a building of 260 m3 provided that obvious leakage paths such as flues, air bricks and extract fan openings have been sealed off. The test should not be undertaken if the average wind speed at the time is greater than Force 3 (about 5 m/s). The air flow rate is adjusted to give a range of pressure differentials at increments of about 10 Pascals, and recordings of measurements are made after conditions have stabilised. Values should be recorded close to pressure differences of 55, 50, 45, 40, 30, 20, 10 and 5 Pascals. The minimum pressure differential should be below 10 Pascals with the upper value not exceeding 55 Pascals.

Corrections to the air flow rates must be made to take account of the air temperature prevailing at the time of the test

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against that during calibration of the apparatus, and also if there is a temperature difference between indoor and outdoor in excess of 2.5 deg.C.

After the positive pressure test has been carried out, the apparatus is rearranged such that air is extracted from the building or depressurised in a similar way but in reverse order.

An example of graphical presentation of results is shown in Fig.1 and a schematic general arrangement of the apparatus is shown in Fig.2.

Figure 1: Example of graphical presentation of results
(ficticious data)

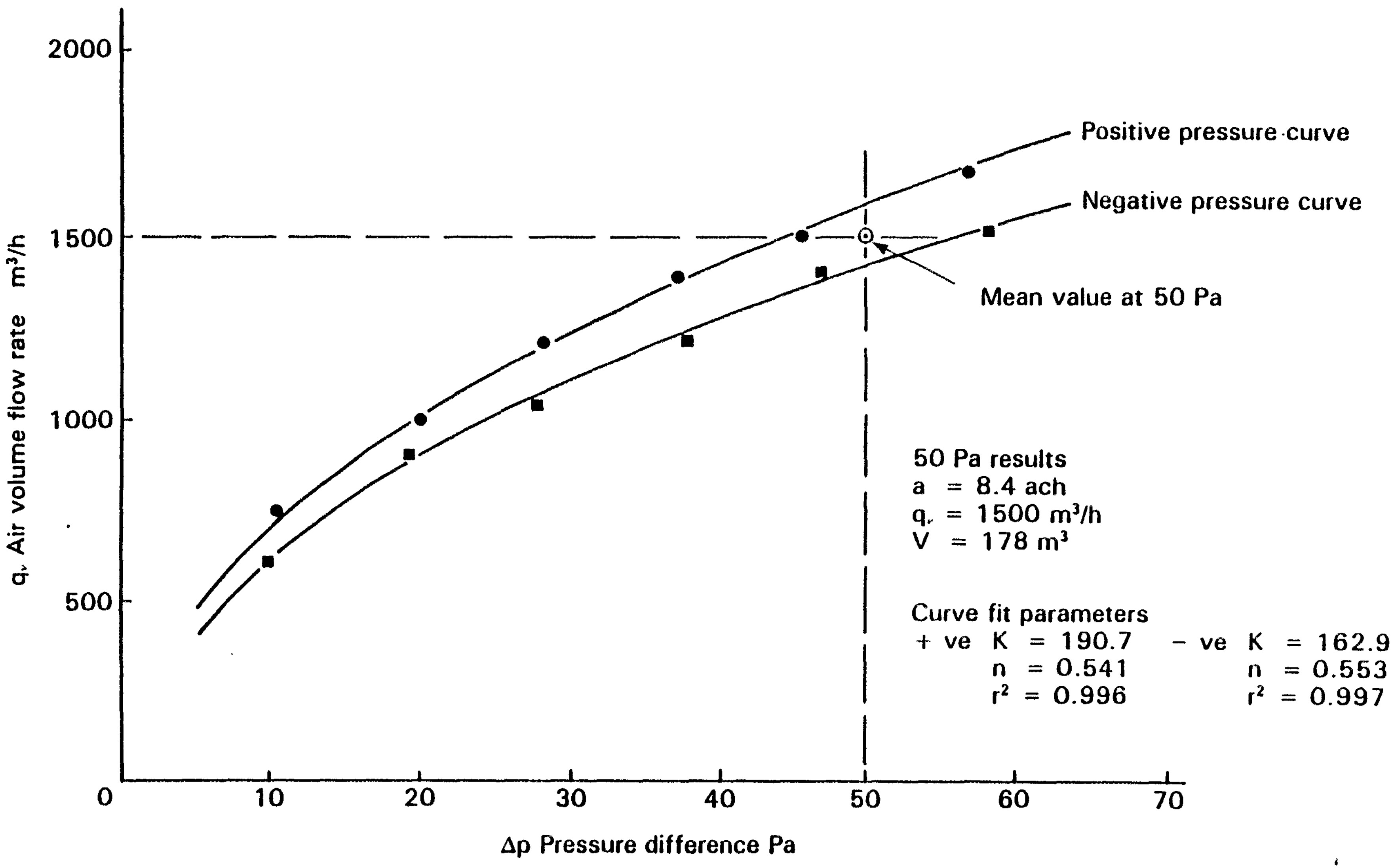

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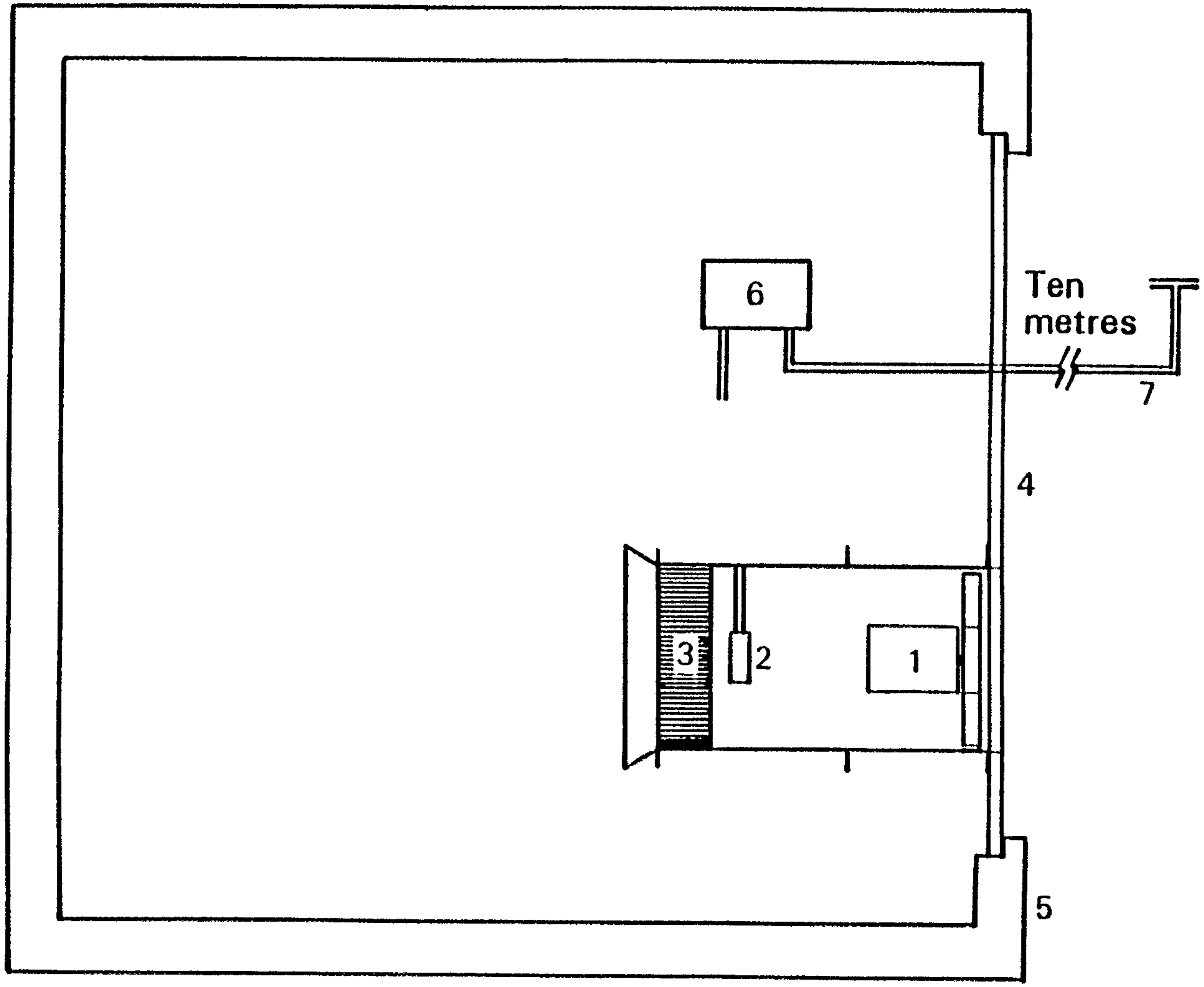
Figure 2: Schematic general arrangement of pressurisation unit installed in a building (shown depressurising)



Key:

1. Fan
2. Air flow measuring anemometer head
3. Honeycomb flow straightener
4. Mounting board
5. Building envelope
6. Pressure difference micromanometer
7. Pressure difference tube

British Standards BS5368 Pt.1:1976

Methods of Testing Windows.

Part 1. Air Permeability Test

1. Scope

This standard defines the method to be used for the air permeability test of windows to be fitted in exterior walls and supplied in the form of finished units in actual operating conditions.

This standard applies to all windows, including door height windows made of any material, in the actual operating conditions in which they should be used and fixed avccording to the manufacturer's recommendations as in a finished building, bearing in mind the conditions of test as defined hereafter. The standard does not apply to the joints between the windows and surrounding components and material.

The standard covers a description of basic test apparatus, preparation of window and testing conditions, and the method of conducting the test.

Test pressures are 50, 100, 150, 200, 300, 400, 500 and 600 Pa and canthen be increased in steps of 250 Pa maximum if the pressure required for the test is, exceptionally, higher than 600 Pa.

The pressures shall than be applied in the reverse order.

The air permeability readings at each pressure are recorded. The higher of the two readings at each pressure, increasing as well as decreasing, should be noted.

For each window tested, the volume of air flow passing through the specimen expressed as cubic metres of air per hour, should be recorded as follows:

(a) per metre of length of opening joint;

(b) per square metre of opening light;

(c) per square metre of total surface area of the window.

These should then be plotted on two graphs against rising pressure.

UNITED KINGDOM Ref:UK.11

British Standard (Draft) 88/13390

Specification for Draughtstrips for the Draught Control of Existing Doors and Windows in Housing (including Test Methods).

Anticipated publication date: February/March 1990.

1. Scope

This British Standard specifies requirements for draughtstrip products to fit the common types of installed doors and windows in housing not originally designed to incorporate draughtstripping, and applies to hinged doors and sliding windows in wood and hinged windows in wood and steel.

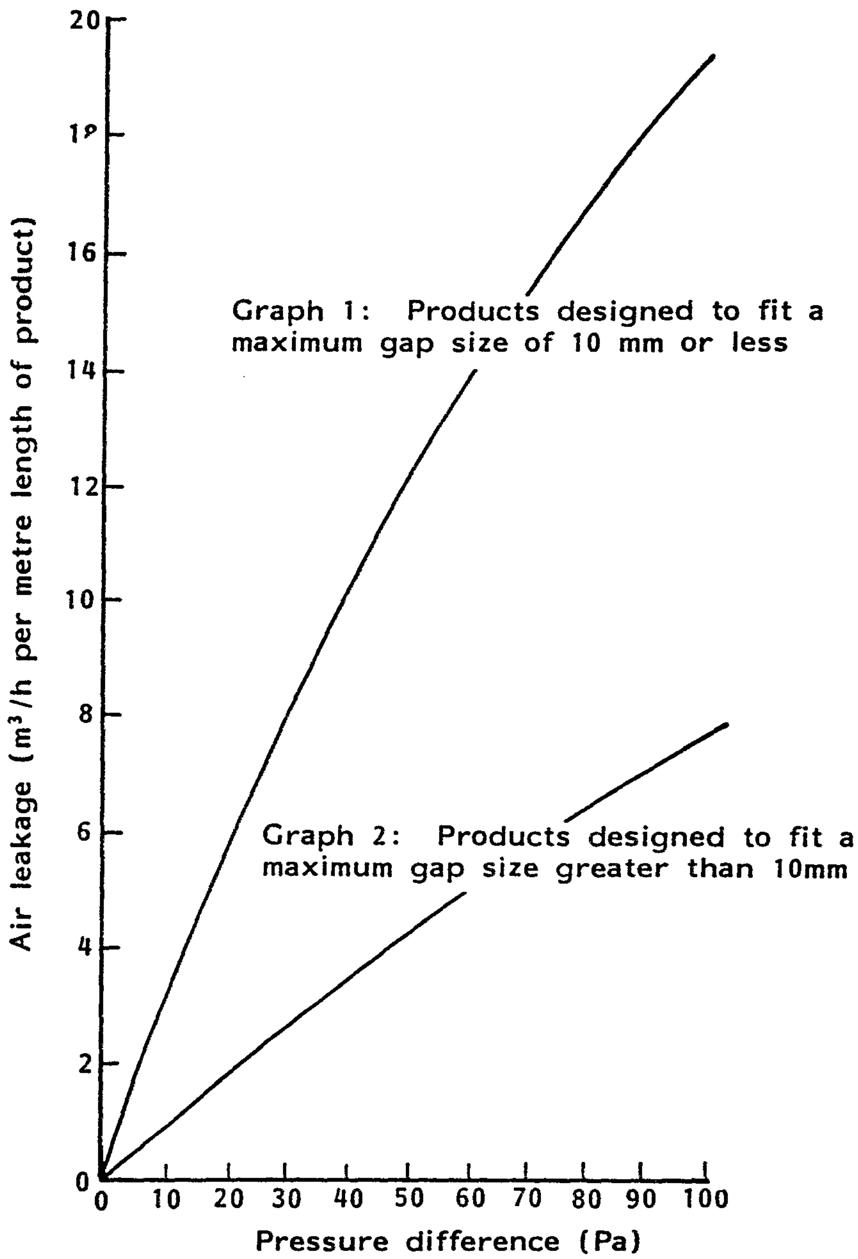
The Standard covers specification of:

- product information
- dynamic characteristics
- performance under sustained compression/deflection
- integrity of working section and carrier of draughtstrip
- air leakage through product
  - (a) for products designed to fit a maximum gap size of 10 mm or less
  - (b) for products designed to fit a maximum gap size greater than 10 mm
- resistance to wear.

Under each specification appropriate testing standards are described.

The airtightness performance/metre length of product is specified for (a) and (b) above, in the draft code, by the figure on the next page.

Figure 1: Maximum air leakage through product v. applied pressure difference.



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